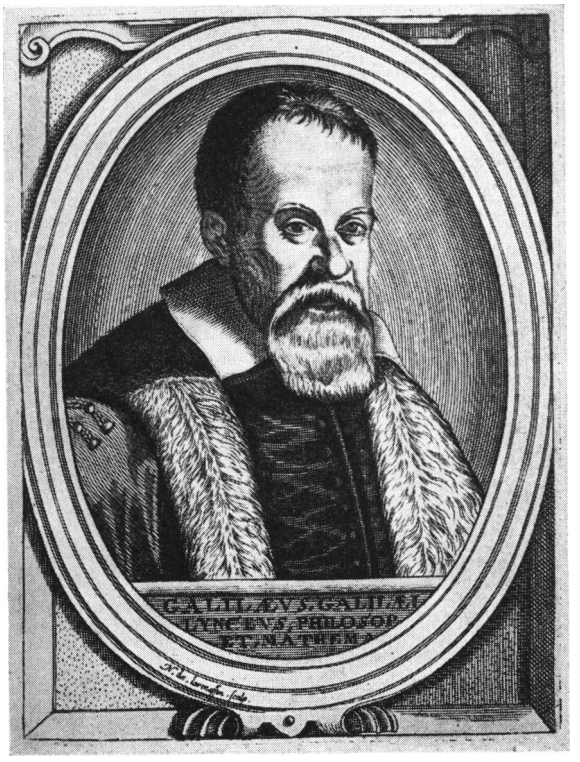

GALILEO*

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GALILEO GALILEI was born at Pisa on February 15, 1564 when the Italian Renaissance was at its greatest height. His father Vincenzo, was an able mathematician, and a skilful musician. Galileo was educated at the monastery of Vallombrosa, near Florence, where he studied Greek, Latin and logic. In 1581 he went to the University of Pisa to study medicine. He devoted several years to these studies, and then yielded to his greater interest in mathematics and physics.

* In commemoration of the three-hundredth anniversary of the death of Galileo held at The New York Academy of Medicine.

While watching a lamp swinging in the cathedral he observed that whatever the range of its excursions they were invariably equal in time. The experimental verification of this fact led him to the discovery of the isochronism of the pendulum. Galileo immediately applied the new principle to the timing of the human pulse.

In 1585 Galileo returned to Florence, and in 1586 published the first description of his invention of the hydrostatic balance. His name soon became known throughout Italy. From 1589 to 1591 he carried on a series of experiments to determine the first principles of dynamics. His demonstration made from the Leaning Tower, before the professors, the students, and the people of Pisa, that bodies of different weights fall with the same velocity, marks an epochal achievement in the history of experimental science. In 1592 he was called to the University of Padua where he held the chair of mathematics until 1610. There he attracted the attention of students and persons of distinction who came from every part of the world.

The men of the Renaissance had set out to explore the nature of man and the cosmos. Man then was disclosed through the study of anatomy, pathology, physiology, and biology. Vesalius had already revolutionized the study of anatomy; Paré had modernized surgery. The studies of Cesalpino and Fabrizio had solved many important physiological problems, and Fracastoro had launched the new doctrine of the infectious nature of certain diseases. At this time too the discovery of countries, of plants, of animals, and of human species, until then unknown, further extended the intellectual horizons of the Age. The universe appeared then infinitely larger and more vast than the human mind had been able to conceive it. The relationships of man with all living things, with the sky and the earth, with animals and plants, appeared very different from those which had been accepted until then, and which had placed man in the center of the universe. Nevertheless, the belief that the earth was the center of the cosmic system seemed, because of its dogmatic character, to be unassailable and impregnable. Copernicus' discovery, though wonderful in its grandeur, had upset neither the supporters of the Ptolemaic doctrine nor those who believed every contrary statement to be inadmissible and heretical. The Copernican doctrine, expounded in a book written in rather obscure terms, and aiming primarily at the reform of the calendar, had not yet roused the protests of the strict supporters of the dogmas. Galileo, who had

begun by destroying with experimental proofs the principle of Aristotelian mechanics, had collected all the facts justifying complete acceptance of the Copernican theory, and had sensed the importance of Kepler's demonstration in 1609 that planetary orbits are elliptical. This discovery ended the Aristotelian dogma, which held that no celestial movement was possible except in a circular pattern.

Galileo succeeded in 1609 in producing a telescope of three-fold magnifying power; later he improved it until it had a magnifying power of 32. His instruments, of which he manufactured hundreds, were soon in demand in every part of Europe. His astronomical observations made with the aid of his telescopes so perfectly substantiated the truth of the Copernican doctrine that in 1610 he publicly proclaimed his convictions in the book, *Sidereus Nuncius.*

Galileo's discovery of the phases of Venus and of the satellites of Jupiter gave added proof to his belief. To save the crumbling edifice of dogmatism, however, the Tribunal of the Holy Inquisition declared the doctrine that the sun and not the earth is the center of the universe, and that the earth moves in its own orbit, to be absurd and heretical.

In 1632, at the time when the scientific world was upset by Harvey's discovery and experimental proof of the circulation of the blood, Galileo published in Italian, that is in a language accessible to the common people, his *Dialogo dei due Massimi Sistemi del Mondo.* This was greeted with tumultuous applause in every part of Europe. The strength and clearness of scientific exposition were here happily combined with great elegance of style. But this remarkable book was in flagrant violation of the decree of the Holy Office, and the author was cited to Rome by the Inquisition. On June 22nd the Tribunal compelled the 70-year-old man to recant, sentencing him to incarceration at the pleasure of the Tribunal, and enjoining him by way of penance to recite once a week for three years the seven penitential psalms. The judges doubtless had the illusion that they had defeated every attempt at rebellion, and had saved dogma by means of a punitive decree.

In reality however, Galileo's demonstrations effected a great revolution in thought to which the discovery of the microscope gave added impetus. In 1610 Galileo had adapted telescope lenses to the magnification of extremely small objects and constructed an instrument for the examination of the organs of very small animals. In 1614 he spoke about it to several friends, and Détarde, a scientist who visited him at

Florence, stated that with the aid of this instrument he had seen flies that were as big as sheep, and had observed that they are covered with hair and provided with angular joints. To this instrument a Greek scientist, Demisciamo, member of the Accademia dei Lincei to which Galileo belonged, gave the name "microscope." About the same time Galileo constructed the first thermometer, an air-thermoscope consisting of a glass bulb containing air connected to a glass tube or small ball dipping into a colored liquid. These successes of Galileo were in large measure due to his skill in perfecting the instruments he employed. He was thus the inventor of an effective telescope and of the compound microscope.

Galileo's conception of a mechanical universe dominated by mathematical laws swiftly reacted on the biological sciences. His conception of the cosmos proved that mechanical principles rule alike in the movements of the heavens and in the changes on the earth, in the revolution of a planet's satellites and in the structures of the human body.

Galileo's work was, therefore, not only creative in the field of astronomy but affected all scientific thought from its foundation. Scientific thought turned definitely toward experimental research following his principle: "the right way to attain truth is to put experience before all discussions." Attacking dogmatism with the greatest courage, he affirmed: "it is foolish to seek the meaning of natural things in the writings of this or that author, rather than in the works of nature which are always alive and at work before our eyes, true and unchanging in all their manifestations."

Galileo spent the last years of his life in his villa at Arcetri, in the strict seclusion which was the prescribed condition of his comparative freedom. His mental activities, however, continued undiminished till the last day of his life. He published in 1636 his *Dialoghi delle Nuove Scienze* in which he summarized the results of his experiments. His last discovery—of the moon's diurnal and monthly digressions—was made in 1637. Then he became blind. His genius, however, was at work until the last moment. As a teacher, as a philosopher, as a thinker, he was still active when he died on January 8th, 1642.

Based on Castiglioni's *The Renaissance of Medicine in Italy*, published by the Johns Hopkins University Press, Baltimore, Md., 1934; and *A History of Medicine*, published by A. Knopf, New York, 1941.